Space Weather Technical Forecast

Issued on Sunday 16 March 2025 at 12:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares likely. Chance G1/Minor Storms Days 1-2 (16-17 Mar). Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with the peak flare C4.2 at 16/0803 UTC from AR4019 in the northwest disc. There are currently twelve regions on the visible disc. AR4021 in the south-centre is perhaps the most notable region currently on the disc, with recent flux emergence on its southern edge and a weak delta spot developing. Recent growth does appear to have stalled, however. Previous region of interest AR4019 in the northwest continues to fade, with the trailing spots very faint. In the southeast AR4028 has seen some ongoing emergence of intermediate spots, however this maintains a relatively simple magnetic structure. Weak growth is apparent in some of the regions in the north disc, including AR4022, AR4025 and AR4031. Remaining regions appear small and/or simple at the present time.

No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, showed the ongoing fast wind of CH22/- starting to ease. Speeds declined from elevated levels around 550 km/s to slightly elevated near 450 km/s. Density was average or below. Interplanetary Magnetic Field, Bt, was weak below 6nT, with the north-south component, Bz, also weak and variable, ranging between +/-5nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was moderate to high, with a peak of 4950 pfu at 15/1545 UTC. The 24-hour fluence was above Active (1e8 integrated pfu) throughout, reaching 1.38e8 integrated pfu at 16/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with an ongoing likelihood of isolated M-class flares and a slight chance of an X-class flare.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing fast winds continue to ease a little Day 1 (16 Mar), before a further enhancement is likely later Day 1 or Day 2 (16-17 Mar) from any fast winds and CIR associated with CH23/-. This enhancement is low

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confidence, however. Solar winds then easing towards background Days 3-4 (18-19 Mar). Mainly Quiet to Unsettled activity is expected at first, however any further fast wind enhancement from CH23 will likely bring a spell of Unsettled to Active intervals with a chance of reaching G1/Minor Storm, mainly on Day 2. Geomagnetic activity then easing to become Quiet to Unsettled again later in the period.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement should there be any larger flares. High energy electron flux is expected to continue to reach high levels at the diurnal maxima, with Active (1e8 integrated pfu) fluence continuing Days 1-2 (16-17 Feb) before potentially easing. However confidence lowers later in the period.

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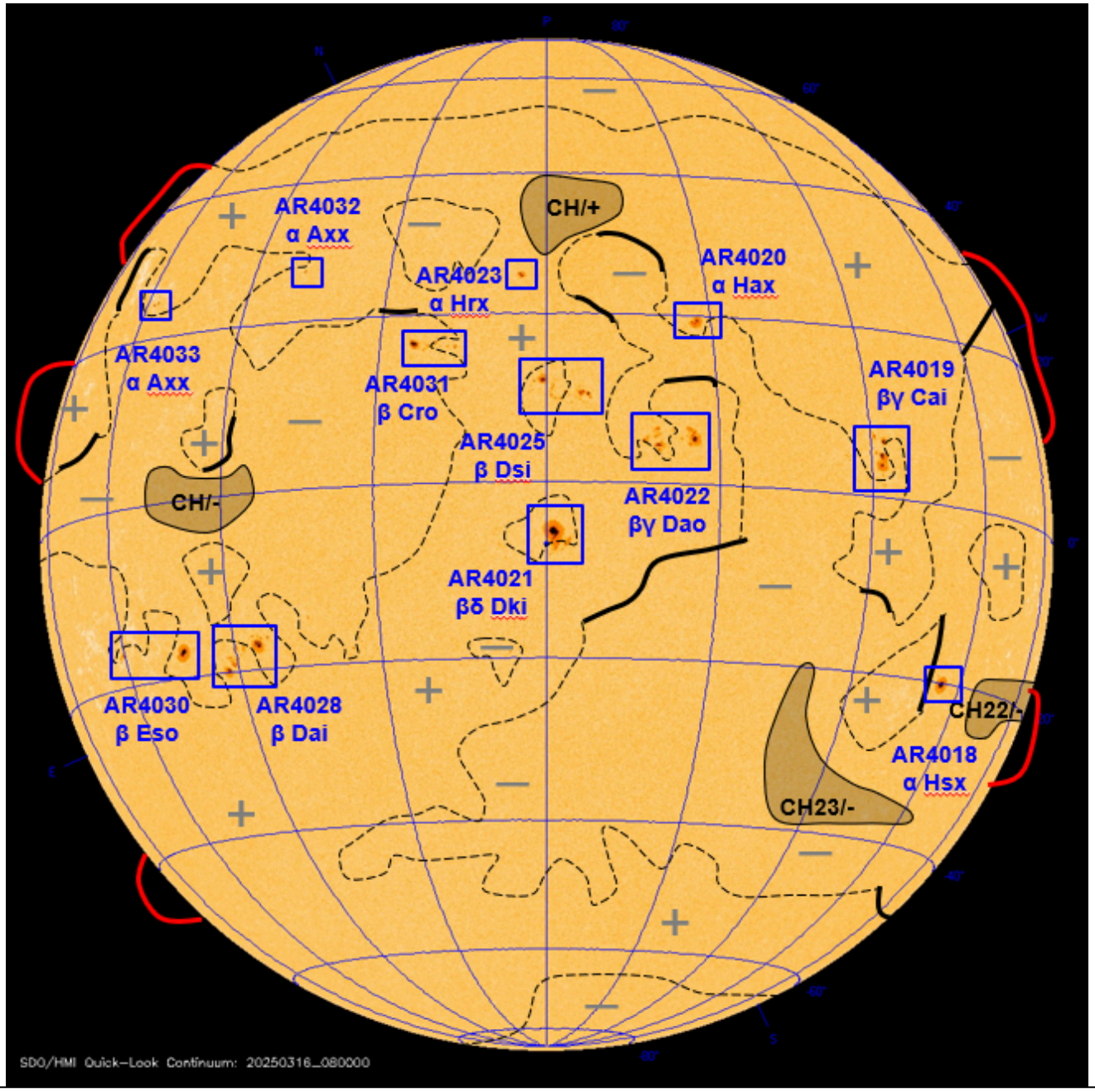
Figure 1: Solar synoptic map, valid 16/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs.

The fast wind enhancement from CH22/- is slowly easing, with wind speeds now slightly elevated. Wind speeds are likely to continue easing a little at first, however the next potential enhancement could occur either late Day 1 or more likely Day 2 (16-17 Mar). This is due to any fast wind from the northern extension of CH23/-, the leading edge of which is located around 35W at time of writing this forecast, and with potential wind speeds of 500-600km/s, this would likely result in any CIR onset within the next 24 hours.

This is low confidence however, both due to the feature being located further south than CH22/- which brought the more recent enhancement, but also as this feature was observed only as a continuation of the previous fast wind enhancement as a single feature on the previous solar rotation. Furthermore MOSWOC Enlil suggests solar winds will see the current fast winds starting to ease on Day 2, reaching background speeds by Day 4 (19 Mar).

Mainly Quiet to Unsettled activity is expected at first, however any further fast wind enhancement from CH23 will likely bring a spell of Unsettled to Active intervals with a chance of reaching G1/Minor Storm, mainly on Day 2. Geomagnetic activity then easing to become Quiet to Unsettled again later in the period.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	20	30	5	1
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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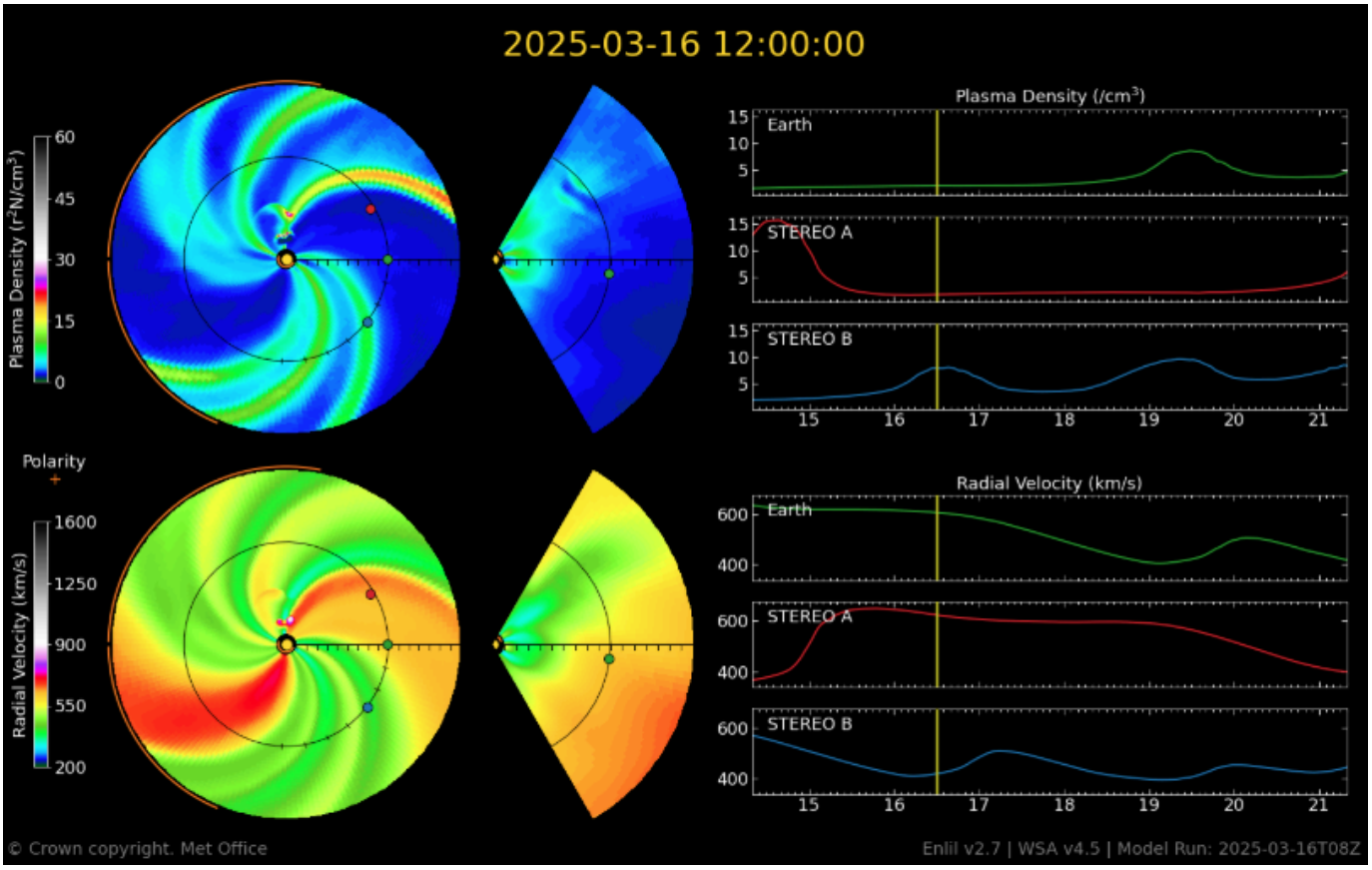
Figure 2: MOSWOC Enlil, showing a gradual decline in winds speeds through the next few days. It is perhaps more likely there will be an increase through the next 24 hours or so, and then a slow easing.



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Radio Blackouts - X-Ray Flares

Solar activity has been Low with the peak flare C4.2 at 16/0803 UTC from AR4019 in the northwest disc.

There are currently twelve regions on the visible disc. AR4021 in the south-centre is perhaps the most notable region currently on the disc, with recent flux emergence on its southern edge that has resulted in a more complex bipolar anti-Hale region (reverse polarity for that typically expected in the southern hemisphere), and a weak delta spot developing. Recent growth does appear to have stalled, however. Previous region of interest AR4019 in the northwest continues to fade, with the trailing spots very faint. In the southeast AR4028 has seen some ongoing emergence of intermediate spots, however this also maintains a relatively simple magnetic structure. Weak growth is apparent in some of the regions in the north disc, including AR4022, AR4025 and AR4031. Remaining regions appear small and/or simple at the present time.

Low to Moderate activity is expected, with an ongoing likelihood of isolated M-class flares and a slight chance of an X-class flare.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: X-ray flux at GOES16 and 18, showing just C-class flares in the last 24 hours.

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with a slight chance of enhancement due to the current inactivity of the small regions on the Earth-facing disc. However, as more of these move into the western disc, and with any potential ongoing development e.g. of AR4021, this could slightly increase the potential for any eruptions resulting in observable protons at GEO.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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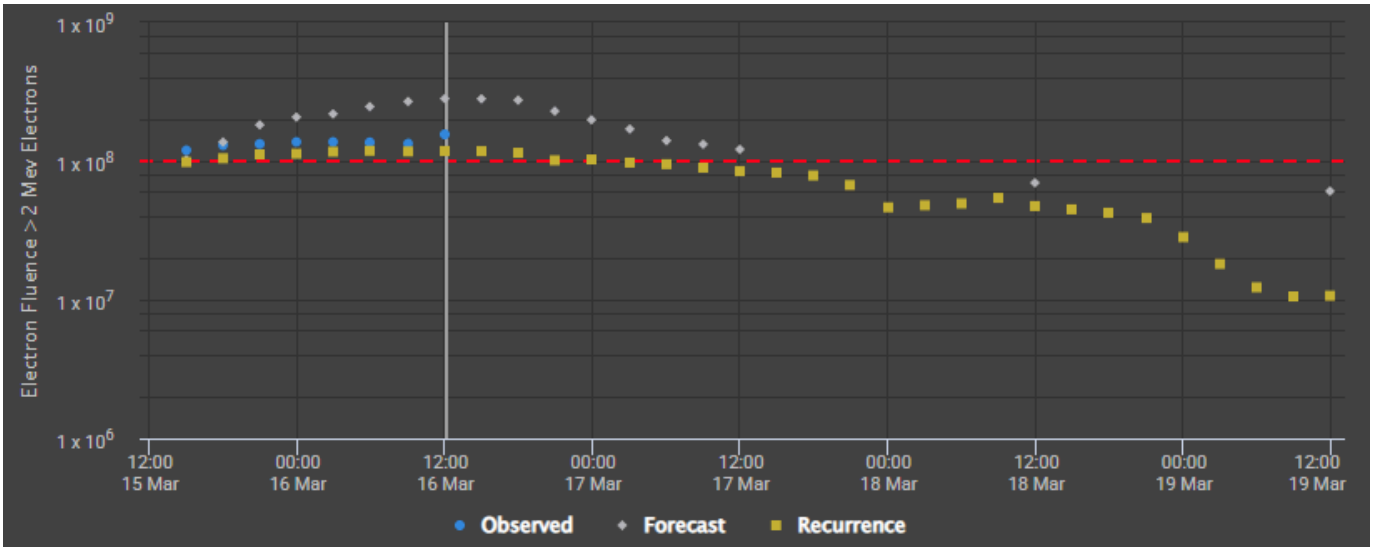
High Energy Electrons (≥ 2MeV)

The recent fast wind and associated geomagnetic activity from CH22/- has caused an increase in electron flux in the Van Allen belts. Now the wind speeds from this feature are easing, it has allowed the Van Allen belts to expand towards GEO, with a consequent significant increase in flux at GOES-16 in recent days, reaching persistently high levels especially at the diurnal maximum. This is expected to continue, but with a chance of a brief period of drop out from any fast wind enhancement either late Day 1 or early Day 2 (16-17 Mar). Beyond this, a gradual and erratic decay of the observed flux is likely, similar to the previous rotation, although probably occurring more slowly than recurrence suggests. Further periods of high flux are expected, but these perhaps becoming shorter in length with lower peaks.

The associated 24 hour fluence is expected to continue above Active (1e8 integrated pfu) Days 1-2, but with confidence for this to persist into Days 3-4 (18-19 Mar) gradually falling. This is supported by 27-day recurrence. MOSWOC REFM is currently overestimating the observed flux, but is now forecasting a decline in fluence over the coming days.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	Yes	100	80	60	30
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM showing above Active fluence, but forecasting a gradual decline.



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